Selecting an Open Innovation Community as an Alliance Partner: Looking for Healthy Communities and Ecosystems

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Abstract

Organizations build strategic alliances with other firms with the intent of tapping into partners' resources and capturing long-term value from these relationships. Such partnerships are typically governed by contractual or equity arrangements with clear mutual obligations. More recently, however, organizations started seeking strategic partnerships with open innovation communities, which are new digitally-enabled forms of organizing where contractual commitments are not possible. Selecting the right open innovation community as an alliance partner thus becomes a more difficult decision. We follow how organizational decision makers in two technology firms that were pioneers of forming strategic alliances with open innovation communities developed metrics around making such decisions. We build upon Shah and Swaminathan's (2008) contingency model of alliance partner selection to consider how it applies to the case of partnering with open innovation communities. While we find that this framework is useful in framing our findings, we point out two key differences: 1) the evaluation metrics used in picking an open innovation community were more focused on value creation rather than value capture; and 2) open ecosystem considerations and not just partner-specific metrics featured prominently in this type of alliance partner evaluation. We develop the notions of community and ecosystem health to refer to these new metrics.

Keywords

Strategic alliances, partner selection, open source community, open innovation, open ecosystem, company engagement with open source, company-community relationship

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"*Here's a technology. How powerful is the community that's using this technology? How stable is that community? Do I want to invest my business in it?*" (Red Hat CEO, James Whitehurst, 2013)[1].

1 Introduction

Inter-organizational literature is rich in studies on how and why ties are built between organizations (Gulati and Gargiulo 1999; Kenis and Knoke 2002; Khanna and Rivkin 2006), especially those ties that enable digital innovation across an ecosystem (Helfat and Raubitschek 2018; Nambisan et al. 2017). This body of work emphasizes how the desire to tap into resources faster than competition and innovate by combining diverse sources of expertise (Hoang and Rothaermel 2005) compels organizations to look beyond their own boundaries (Gianni and Andrea 1999; Parmigiani and Rivera-Santos 2011).

While firms are increasingly engaging with external partners for innovation and efficiency, how organizational decision makers actually pick an alliance partner is not well understood. We know that organizations are likely to choose partners that they had prior relationships with, but we know far less about how organizational decision makers actually conduct a potential partner evaluation (Furlotti and Soda forthcoming). While picking an alliance partner is not a frequent decision in organizational life, organizations nonetheless develop routines around such evaluations which constitute their alliance management capability (Li and Rowley 2002). These capabilities, however, may not be directly relevant when organizations are choosing a non-traditional partner with whom they cannot sign a formal contract or negotiate an equity arrangement (Laura and Todd 2002; Reuer and Africa 2007; Ryall and Sampson 2009). This is particularly true when new digitally enabled forms of organizing are involved, and organizations seek to partner with open innovation communities (Boudreau and Lakhani 2013; Dahlander and Magnusson 2005; Stam 2009; West and Lakhani 2008).

At the same time, companies, especially technology firms, are increasingly embracing open innovation communities as part of their innovation strategy (Dahlander 2007; Greenstein and Nagle 2014), and nowadays the decision of which communities to partner with is becoming more frequent. A notable aspect of the process of partnering with open innovation communities is that one partner, the corporation, often starts working with the other partner, the community, without the other 'partner' even becoming aware of it. As innovation communities use open processes and produce publicly accessible assets such as code,

[1] Marks, J., and Micheli, M. 2013. "Open Source Tech Is Driving Big Changes in Government," in: *NextGov*. http://www.nextgov.com/emerging-tech/2013/04/open-source-tech-driving-big-changes-government/62839/

designs, artwork, etc., corporations seeking to work "with them" can do so by lurking on mailing lists, downloading non-copyrighted art work, and taking software without asking for permission (Dahlander 2007; De Silva et al. 2018; Germonprez et al. 2017). These freely accessible resources may mislead decision makers, especially those new to this phenomenon, into thinking that they are not forming an inter-organizational partnership, but rather just consuming goods in a public domain. Yet, there is ample evidence that firms that use such "open" assets over long term become strategically dependent on open innovation communities and face cooperation and coordination challenges common to strategic alliances (Dahlander and Magnusson 2008).

While we are accumulating more and more research about the nature and implications of company engagement with open innovation communities (Afuah 2017; Bogers et al. 2017; Levina and Fayard 2017; West and Sims 2017), the question of how organizational decision makers select an open innovation community as their alliance partner is still poorly understood. The value of engaging strategically with open innovation communities often does not materialize until later, meaning that companies have to evaluate potential for value creation (Rolland et al. forthcoming) and capture rather than the immediate payback. As a result, managers making decisions regarding open innovation engagements face a great deal of ambiguity (Fayard et al. 2016). This ambiguity is common to many forms of digital innovation as the boundaries between innovation processes and outcomes is murky. This makes it necessary to evaluate not only the potential partner's current capabilities, but also its ability to adjust to future evolving needs (Nambisan et al. 2017).

To investigate the question of how organizational decision makers choose an open innovation community to partner with, we conducted interviews with managers experienced in making such decisions in two firms that have been on the forefront of building alliances with such communities for over two decades. Specifically, we look at how these firms chose which open source community to engage with. Open source communities are a subtype of open innovation communities that have a historical track record of over 20 years (von Hippel 2001; von Hippel 2005). Moreover, organizations tend to choose an open source community often irrespective of which technological platform it is hosted on, while for newer forms of open innovation communities such as those producing art works or solving scientific problems, the choice of the platform provider that "hosts" the community often precedes the choice of the community. We adopted Grounded Theory Method (GMT) (Charmaz 2014; Glaser and Strauss 1967) and collected data from open-ended interviews and archival documents to learn how managers that, in fact, started facing a choice of communities to engage with as the practice of open sourcing became more widespread actually made such choices. Our findings reveal that after a number of initial setbacks and surprises in early years, managers leading open source projects were able to develop new approaches for

choosing an open innovation community. We analyze their setbacks and successes and develop a framework showing how managers *probe* for a *healthy community* and a *healthy ecosystem.*

2 Background Literature and Theory

2.1 Partner Selection in Alliance Building

While strategic alliance literature is rich and well established, its primary focus has been on commercial inter-firm relationships governed by contractual or equity arrangements. Given the novelty of digital organizing, it is not surprising that this research has not focused on how organizations form alliances with open innovation communities. Yet these new types of external relations share some of the same aims as those characterizing commercially-governed strategic alliances. Kale and Singh's (2009) extensive review of the strategic alliance literature provides a classification of commercial governance mechanisms and aims of diverse inter-organizational relationships. Their writing distinguishes strategic alliances from other types of interfirm relations through the nature of its long-term strategic scope rather than through its governance mechanism (contract or equity). In particular, they term "non-traditional contractual partnerships" as alliances that include aims such as conducting joint R&D and marketing activities, accessing mutually complementary assets and skills, and participating in joint standard setting. Open and user innovation literature demonstrates that firms that engage with open innovation communities over the long term typically share the very same aims (e.g., Afuah et al. 2018; Dahlander and Magnusson 2008; von Hippel 2005). Thus, while strategic alliance literature has not discussed such arrangements directly, it may still offer fruitful insights on how companies may go about selecting a strategic partner, albeit with the caveat that it reports on studies of partnerships governed by commercial terms.

There are three main streams of research that focus on partner selection in alliances (see Table 1). The first stream argues that alliance partners are largely chosen based on a partner's ability to provide resources that the other partner is seeking at the time of partnership formation (Furlotti and Soda forthcoming; Mitsuhashi and Greve 2009). This very rich stream of research establishes that firms seek partners with both complementary resources (where differences in resources are seen as productive) and compatible resources (where similarity in resources makes collaboration among firms more feasible) (Mitsuhashi and Greve 2009). More recent work adds nuance to this perspective by arguing that beyond the alliance's strategic goals, the needs of a specific task for which the alliance has been formed and the relative power associated with each partner's own resources shape alliance tie formation (Furlotti and Soda forthcoming). Literature on corporate engagement with open innovation communities echoes the sentiment that partnerships with such communities are often based on complementarity and compatibility of task-related resources involved in the relationship. Corporations often partner with communities to

innovate on specific tasks by tapping into resources that they are missing internally (Afuah and Tucci 2012; Dahlander and Wallin 2006; Felin and Zenger 2014), but for which they have relevant absorptive capacity (Lichtenthaler and Lichtenthaler 2009), complementary IP (Lakhani and Lonstein 2011), and/or access to markets (Vanhaverbeke et al. 2008). The literature argues that these complementary resources allows corporate partners to capture value generated by the relationship with the community.

The second stream of literature embraces the importance of resource considerations in the choice of a strategic alliance partner but points out that such partnerships are built for the long term and hence entail dealing with a significant amount of change and adjustment. This perspective highlights the importance of looking at the phenomenon dynamically and accounting for the alliance development processes (Das and Teng 2000; Koza and Lewin 1998). This perspective pays special attention to the co-evolution of the partner relationship as partners learn more about each other, discover new sources of value, and develop capabilities specifically to address the other partner's needs (Koza and Lewin 1998). Keeping an eye on long-term value creation based not only on the current situation but also on the potential for resource development and relationship evolution can become an important strategic consideration (Das and Teng 2000). Moreover, researchers have found that past experience with a specific partner in other business relations (e.g., alliances formed for a different task) and their willingness and ability to adjust to the focal firm's needs is likely to lead to the same partner being selected again for a new task (Li and Rowley 2002). The focus on the alliance development process and relationship co-evolution is particularly likely to be relevant to our research context as engaging with a community for an innovation-related task is full of uncertainties, ambiguity, and turbulence (Felin and Zenger 2014; Germonprez et al. 2017).

The third stream of research points out that new partnerships arise on the basis of historically established formal and informal social network ties. Specifically, organizations often partner when they belong to a single legal entity such as a parent company (Faems et al. 2008; Gulati 1995; Reuer and Africa 2007), when they are part of an inter-organizational business network with a common third party who may serve as a broker, or when they occupy a particular structural position in an inter-organizational network (Furr and Shipilov 2018; Obstfeld 2005). This literature pays special attention to the social capital that accumulates in inter-organizational networks. It often refers to relational contracting (Baker et al. 2002) as a mechanism for preventing opportunistic behavior and ensuring long-term cooperation. Relational contracts in strategic alliances complement or even subsume formal contracts (Laura and Todd 2002; Ryall and Sampson 2009), which are hard to specify fully in long-term uncertain relationships. Relations in a business network help foster new ties through trust-building mechanisms, potential partners' global and local reputations, and their social network position (Carson et al. 2006). Given that corporations often engage with open innovation communities without a formal contract and rely heavily on building good

relationships, the network perspective on alliance formation may be particularly relevant to us (Dahlander and Magnusson 2008; Dahlander and Magnusson 2005). Open innovation literature highlights the importance of relational governance over other types of governance (e.g., contracts, contests, employment) when engaging with an open innovation community as opposed to other forms of open innovation (Felin and Zenger 2014). Moreover, strong network effects in digital goods markets (Eisenmann et al. 2009) further increase the importance of this perspective in our context.

Table 1: Literature Streams on Partner Tie Formation in Strategic Alliances

Streams	Focus	Sample papers
Resource complementarity, compatibility, and fit	This stream argues that alliance partners are selected based on matching task or project needs with the resources that alliance partners have (to address this need).	(Furlotti and Soda forthcoming; Kale and Singh 2009; Li and Rowley 2002; Mitsuhashi and Greve 2009; Premkumar et al. 2005; Shah and Swaminathan 2008; Zhiang et al. 2009)
Potential for productive partner co-evolution	This stream acknowledges the dynamics in alliance relationships and argues that partners may be chosen based on their future potential and may emerge or dissolve as the partners and the network around them evolve.	(Das and Teng 2000; Doz 1996; Koza and Lewin 1998; Li and Rowley 2002)
Social relations in an inter-organizational network	This stream sees contracts, both market and relational, as the basis of partner selection in alliances. Alliance ties are formed based on prior ties, common third parties, or specific structural positions in inter-organizational networks.	(Faems et al. 2008; Figueiredo and Silverman 2017; Furr and Shipilov 2018; Gibbons and Henderson 2012; Gulati 1995; Obstfeld 2005; Reuer and Africa 2007)

While prior work has focused on analyzing archival data on historical alliance tie formation, recent work has pointed out the need to understand the *evaluation criteria and processes that are actually used by organizational actors* when selecting alliance partners (Furlotti and Soda forthcoming; Shah and Swaminathan 2008). Shah and Swaminathan (2008) published a pioneering study that proposes and tests a framework identifying the relative importance of four key categories of evaluation criteria -- *trust*, *commitment*, *complementarity*, and *financial payoff* - in choosing a partner (see Figure 1). They draw on organizational control theory (Ouchi 1980; Ouchi 1979) to propose that one of the four evaluation factors is likely to dominate the final decision depending on the nature of the task and process involved in the relationship. They identify two key variables that determine which evaluation criteria are most important in choosing an alliance partner: *outcome interpretability*, which refers "to the degree of difficulty associated with being able to interpret or understand with certainty the exact outcomes of a particular project," and *process manageability*, which refers to "the *amount of communication* required by partners for the effective coordination and control of alliance activities" (Shah and Swaminathan 2008, p. 474, emphasis original). Ouchi's (1979, 1980) control theory argues that when outcome interpretability is low,

a project owner has to rely more on process/behavioral rather than outcome controls. If process controls are also hard to establish, often due to the lack of the project owner's knowledge about the process, then one has to rely on "clan" controls – usually associated with common identity, reciprocity, mutual trust, and shared culture. Shah and Swaminathan (2008) argue that alliance partners are evaluated primarily based on their likelihood to fit a particular alliance control approach that is likely to govern the partnership. For example, financial payoffs are most important when planning to use outcome controls, while trust dominates the decision when planning to use clan control.

	Process manageability: Low (difficult)	**Process manageability: High (easy)**
Outcome interpretability: Low (difficult to interpret)	Most critical: *Trust*	Most critical: *Complementarity*
Outcome interpretability: High (easy to interpret)	Most critical: *Commitment*	Most critical: *Financial payoff*

Figure 1: Contingency Model of Partner Selection and Attractiveness (Shah and Swaminathan 2008)

Delving further into this framework, Shan and Swaminathan (2008) pay special heed to evaluating the trust potential of the partner, arguing that it can be broken down into *benevolence-based trust* that focuses on a partner's good will and the lack of propensity to engage in opportunistic behavior and *competence-based trust* that focuses on the partner's consistent demonstration of credibility and expertise (p. 474).

While this pioneering paper offers many useful insights, the overall stream of research on decision making processes in partner selection is still in relative infancy, perhaps because it is very difficult to gather relevant data with real organizations. Shah and Swaminathan (2008) had to rely on MBA students analyzing hypothetical scenarios to test their framework. Other researchers had to infer evaluation criteria that probably played into the partner choice by using archival data and comparing ties that were formed to those that could have been formed, but were not (Li and Rowley 2002).

Trying to apply insights of Shah and Swaminathan's (2008) framework to the question of how companies choose which open innovation community to partner with presents many challenges. For one, companies can try to assess the *financial payoff* of the relationship by focusing on specific outputs produced by a community such as ideas, designs, and products. Those could be counted and measured, but they may not lead to financial payoffs given that these outputs are equally accessible to the firm's competitors and given that the long-term reliance on a volunteer community for such outcomes in the absence of any contractual obligations may be problematic (Dahlander and Magnusson 2008; Germonprez et al. 2017). Similarly, one cannot force volunteer members to make a *commitment* to a corporate project. Community

members could be recruited as employees, but this may be met with resistance from the community. Volunteers can also be encouraged to make further commitments if they identify with the firm (Spaeth et al. 2015), but a guaranteed commitment of volunteers is not possible. *Complementarity*, which in Shah and Swaminathan's (2008) framework refers to partners having a joint stake in maintaining a good public image with key external stakeholders such as customers, is also hard to assess. For example, public attitudes towards whether proprietary and open source software are complementary or competing change drastically over time (Dahlander and Wallin 2006; Morgan and Finnegan 2010). Finally, how do firms evaluate potential for building *trust* with an open innovation community before they have had a chance to work with it? Unlike commercial alliances, if an open innovation community fails to cooperate well with a corporation, it may not suffer any reputation losses and indeed may even gain reputation in certain circles (O'Mahony and Bechky 2008; Shah 2006). The question of benevolence-based trust is particularly hard to assess due to the nature of organizing on digital platforms, where a corporate stakeholder may have no way of assessing offline identity of participants. This lack of verifiable identity may expose corporate partners to strategic risks if such anonymous participants are, for example, competitors.

2.2 Partner Selection in Corporate Engagement with Open Innovation Communities

Organizations may engage with open innovation communities, and in particular open source communities, for a variety of reasons. In the simplest case, they may use open source software in their daily operations for cost-saving reasons (Kwan and West 2005). Increasingly, however, firms seek strategic value from engaging with open source communities that comes from co-developing software and services with open source communities (Agerfalk and Fitzgerald 2008; Dahlander and Magnusson 2008; Kwan and West 2005). Prior literature generally posits three types of benefits for such engagement: 1) cost savings that come from using "free" external code, documentation, and testing; 2) innovation potential of co-developing products with a diverse community of contributors and speeding up innovation; and 3) increasing adoption of software by making it open, which deters competition and enables sales of complementary products and services through the ecosystem (Baldwin and von Hippel 2011; Dahlander and Magnusson 2008; Dedrick and West 2007; Kapoor and Agarwal forthcoming). The literature suggests, however, that there are significant strategic risks involved in corporate engagement with open innovation communities stemming from the co-dependency between the firm and the community, the loss of control over what is being developed, the need to protect company IP, and reputational exposure (Baldwin and Clark 2006; Dahlander and Magnusson 2008; Stuermer et al. 2009).

Most work in the area of evaluation in open source software from corporate standpoint addresses only the first goal of cost reduction by focusing on evaluating various aspects of the software code and accompanying documentation. Besides evaluating which software features are supported (Gupta and

Singla 2012; Mijinyawa and Abdulwahab 2014; Money et al. 2012), this research discusses traditional metrics for software quality (Fuggetta 2003; Spinellis et al. 2009; Stamelos et al. 2002), maturity and reliability (Aberdour 2007; Petrinja et al. 2009), and maintainability (Samoladas et al. 2004). The recommended assessments focus both on direct measures, such as the number of lines of code, availability of documentation, number of commits and bug reports, and quality of test plans, as well as indirect measures, such as the number of downloads, which is argued to be a good proxy for quality (see Vijaya et al. 2017 for a recent review). However, this literature also acknowledges that in practice, *formal evaluation criteria are rarely used*, and that familiarity with the product often drives the selection (Torchiano and Morisio 2004).

Besides open source literature focused on software evaluation, we have not found any literature that focuses on choosing which community has a good potential to serve as a corporate innovation partner – the second key goal of such relationships. Most studies on open innovation communities either focus on a single community working with a single corporation (e.g., Schlagwein and Bjørn-Andersen 2014) or study experiences of different firms each working with a specific open innovation community trying to unpack what happens once the relationship has already been established (Dahlander and Magnusson 2005; Germonprez et al. 2017; Naparat et al. 2015). There is a significant body of literature focused on factors that enable sustainability of open source communities and ecosystems (Crowston et al. 2006; Jansen 2014), but this literature is typically not concerned with corporate engagement and takes an "inward" perspective.

Regarding the third key strategic value, namely, the desire to speed up the adoption of new products and services through this model, the discussion of which community would help a firm achieve this goal is also missing. A firm can capture value through such engagements by deterring competition and commercializing complementary products and services (Adner 2006; Alexy and Reitzig 2013; Dahlander and Magnusson 2008; Zhu and Zhou 2012). Yet, a community is often engaged with other for-profit firms potentially competing with the focal firm in trying to capture value created through an open ecosystem (Adner 2006; Davis 2016; Gulati and Gargiulo 1999; Helfat and Raubitschek 2018; Nambisan et al. 2017). Because most empirical studies of corporate engagement with open innovation consider one digital ecosystem at a time (e.g., Linux), the question of how a choice of a partner community influences firm's engagement with a wider ecosystem has not been researched.

Aside from a robust set of metrics used for assessing software quality, it is apparent that the literature has generally remained silent on how corporations make a choice among alternative communities for long-term engagement. We focus our investigation on this important question: *how do organizational decision makers select an open innovation community as their alliance partner?*

3 Methodology

A grounded theory-building approach (Charmaz 2011; Glaser 1987; Glaser and Strauss 1967) was chosen because our goal is to develop a theoretical understanding of a relatively new and poorly theorized phenomenon. We embraced an abductive approach to grounded theorizing (Charmaz 2011; Charmaz 2014; Charmaz and Belgrave 2015; Richardson and Kramer 2006) that maintains that researchers always bring their prior knowledge and research interests in theorizing a phenomenon, and hence the theory developed on the basis of data is not purely inductive in its nature (Urquhart and Fernandez 2013).

3.1 Research Sites

During our initial data collection in early 2010, we became interested in exploring broad issues associated with firm engagements with multiple open innovation communities. With very few firms at the time having extensive experience with multiple open innovation communities, obtaining access to corporate decision makers who have considered more than one open innovation community as a potential partner was a challenge. It was important that we obtained cooperation at the firm level, as opposed to solely individual decision makers in order to corroborate interviews with archival records to reduce recall bias. We obtained access to a leading technology firm (Company A[2]) that was one of the pioneers of corporate engagement with open sourcing. We gained entry when a senior manager, who after attending the first author's presentation at a conference, expressed interest in participating in a research project on open source engagements. When collecting data from Company A, we decided to seek another firm with rich open sourcing history because we had exhausted relevant interview subjects at the first firm but had not yet reached theoretical saturation (Glaser and Strauss 1967; Guest et al. 2006). We wanted to find firms with similar histories of open source engagements so as to make decision-level analysis across both firms more comparable. We were able to negotiate access to Company B by soliciting participation on a mailing list of open source developers and inviting those with corporate email addresses to contact us.

Company A and B were fairly similar in terms of firm size, global business model (MNCs), workforce composition, market position, and brand. They also had similar histories of engaging with multiple open source communities for more than a decade. Company A started its journey slightly before Company B and engaged with a greater number of communities, which resulted in it having experienced more "growing pains" as a pioneer, as well as showing greater evolution in its thinking than Company B. In addition, Company A engaged in a greater number of end-user focused applications developed by open source communities. In our analysis, this meant that Company A ended up paying more attention to network effects associated with open source product ecosystems than Company B.

[2] Both company names are pseudonyms used to protect the identities of the research site and respondents

There were no other notable differences revealed in our data between Companies A and B when it came to the research question we posed. Both firms engaged with close to 100 open source development projects and stated publicly that they had contributed 1000+ employees to these communities. Both firms continued to use more traditional methods of in-house software development alongside open source community engagement. Respondents from both firms stated similar reasons for engaging with communities; both firms sought a strategic first-mover advantage with a particular community and were exploring a new model of competition more broadly.

We reached theoretical saturation in our data collection after 39 interviews across two firms, and towards the end, our emergent theory began to explain the newly collected data quite well (Glaser and Strauss 1967; Guest et al. 2006). To ensure that our findings were not specific only to large, leading technology firms, we interviewed two additional senior decision makers from smaller firms that had a history of repeated community selection decisions because they focused their strategies on partnering with open source communities (Dahlander 2007). While we focus our analysis and writing on the data collected from Companies A and B, the data from these new interviews reinforced our findings.

3.2 Interviews and Documents

While our data collection involved a broad set of issues around corporate engagement with open innovation communities, in this paper we draw specifically on data pertaining to how the community choice decision was made. This data came from two sources: 1) in-depth semi-structured interviews and 2) archival documents. Table 2 summarizes the data that were analyzed for this paper.

Table 2: Data Used for Analysis

Data Sources	Data Collected	Analytical Purpose
In-depth semi-structured interviews		
- 36 company employees (~ 1-1.5 hours) - 3 open source engagement leaders (~ 4 hours)	- 996 single-spaced pages of interview transcripts	- Understanding construction of value of open source engagement - Open source engagement history and management practices at each firm - Differences in subjective judgements vs official statements
Archival documents		
- Online company materials and reports - Public blogs and news clippings - Meeting minutes - Slide decks used to explain open source engagement to other	- 47 (Co A) + 62 (Co B) documents on open source engagement - 21 public reports & numerous news articles - 36 meeting minutes - 49 slide decks	- Understanding company background with open source engagement, and media view - Detailed data on specific open source engagement projects (numbers, types, and durations) - Comparison with subjective perceptions reported in interviews - Comparison between public vs internal justifications

stakeholders and get their support		- Evolution of open source engagement strategy, practices, and evaluation over time

3.2.1 Interviews

In 2010 and 2011, we conducted 39 interviews with US- and European-based employees across both companies. Each interview lasted for at least an hour and a half, but interviews with key informants who had been with each company for many years and were leading open source engagement efforts lasted as long as 4.5 hours. They were carried out in person (14) and over videoconferencing (30). They involved top and middle managers as well as software developers in open source projects (see Table 3).

This study began with exploratory questions about engagement of companies with open source communities. In early 2010 the literature on open source communities was quite large, but the new phenomenon of corporate engagement with open source was not well understood. Hence, the first author began open-ended interviews with employees from Company A to learn about the goals, processes, and consequences involved in the firm's engagement with open source communities. In initial interviews, the first author noticed that many interviewees were complaining about struggling with questions of which communities they should be engaged with, and which were not worth the effort. At the same time the interviewees indicated that their own understanding of engaging with communities had evolved over time. The first author then revised the interview guide to focus more on the questions of community selection. As a result, the final interview guide explored questions about the nature of the company's engagement with open source communities, what attracted the company to the community, and how the experience of engagement with a given community shaped subsequent community selection and management decisions.

Table 3. Interviews Conducted

Interviewee Role	Company A	Company B
Senior managers	2	3
Middle managers in technology, marketing, human resources, and strategy groups	15	10
Developers	5	4
Subtotal Company Interviews	***22***	***17***
Total	**39**	

3.2.2 Archival Documents

We collected both public documents from websites, blogs, and news articles and internal corporate documents pertaining to each company's open source community engagements. Interview subjects often shared with us corporate, time-stamped documents, which helped us understand their interpretations of the past (Miller et al. 1997). Of particular value were slide presentations and memos that were sent out

over the years about open source adoption to explain to other stakeholders within the same company the decision-making process and rationale behind open source related decisions. At the time of active data collection (finished in 2011), we found 1095 publicly available documents for Company A, which were mostly technical in nature. Only 47 of them were relevant to evaluation activities that were identified in the interviews. The same search for Company B resulted in 4,230 documents, of which 4,132 were related to technical issues, but only 62 were relevant to our study themes. Public websites for each firm were also used to identify pages discussing each firm's open source engagement activities. The archival data provided solid background context to make sense of each firm's overall goals and of the specific historical references made by managers in interviews.

3.3 Data Analysis

Following GTM guidelines (Glaser 1987; Glaser and Strauss 1967), iterative data analysis took place during the period of intense data collection, which involved documenting emergent themes in memos and using these themes to identify subsequent interview subject, modify subsequent interview questions, and pursue new archival data. We relied on open coding and memoing as our key analytical tools (Charmaz 2006; Rouse 2016).

Our diverse data sources gave us both process and cross-sectional views of the phenomenon that we studied. We developed a cross-sectional perspective on the question based on interviewees sharing with us which evaluation criteria they used in evaluating communities, how these criteria match their organizational goals, and how they compared to what they were used to in choosing corporate partners. We developed a process perspective on our phenomena based on a number of data sources. First, our interviews were conducted over a 2-year period during which corporate open sourcing was maturing as practice. Second, firms A and B started adopting open source at different times, with A demonstrating more mature practices. Third, when we asked our informants about how they made choices among open source communities, they inevitably shared with us both what they were doing currently and how they had arrived at it by learning from their own past mistakes and by discovering new goals for such engagements. Finally, we had access to almost all company documents on how such decisions were made over time, which showed us both quantitative and qualitive evaluation criteria that were institutionalized across the firm. For several key open source projects for each firm, we were able to document in substantial detail the evolution in the goals of such engagements, evaluation criteria, and new challenges. All these sources of data allowed us to draw a distinction between cases when companies were deciding to fully engage with certain communities and when they were merely "probing" by engaging at a small scale to help them conduct a better evaluation.

We transcribed all the interviews and coded them using *Atlas.ti* content analysis software. The initial set of open codes reached 89 categories. A discussion between both researchers helped refine the open codebook down to 61 first-order concepts, which were used for subsequent coding. While the new first order concepts fit the data well and memos revealed some novel insights, the relationship of the first order concepts to our research question lacked parsimony (Walsh et al. 2015). To address this we related our inductive findings to extant literature on corporate open source engagements, software vendor evaluation, alliance partner selection, and ecosystems into our analysis of emergent themes to develop a clearer narrative (Charmaz 2006; Glaser and Strauss 1967).

As part of the process (Muller 2014), we identified the following themes in our memos: 1) distinctive challenges faced by companies when considering to engage with open innovation communities; 2) nature and type of these challenges; 3) evolving formalized and informal criteria used by managers to judge a particular community; 4) changing object of the evaluation (e.g., product, community, ecosystem); 5); relationships of evaluation criteria to value capture, trust, complementarity and commitment; and 6) the tension between judging an observable outcome and trying to control and uncertain process. These allowed us to generalize from the first-order concepts (e.g., "number of core developers who dropped out in protest to corporate involvement in the community") to the second-order themes ("community orientation towards corporate engagements") and aggregate dimensions ("community friendliness to corporation") (following Corley and Gioia 2004). These analyses helped us uncover how decision-making changed over time from looking for open innovation communities as providers of specific products with certain features towards looking for healthy communities and healthy ecosystems. In our final analysis presented in Appendix 1, we found that relating our findings to Shah and Swaminathan's (2008) work helped integrate our insights into a cohesive framework.

In the next section, we will focus on the cross-sectional findings, while also noting how managers recognized that their ability to choose a community shifted from quantitative evaluation criteria assessed at a distance to experiential understanding of whether a community that they are experimenting with is a good long-term partner or potentially could be nurtured to become one. We will elaborate this process-focused perspective further in the discussion section.

4 Selecting an Open Source Community as an Alliance Partner

Commercial alliance partnerships are a common occurrence in software industry, so it is not surprising that managers in our study initially treated the open source community selection process using the same approaches as they were used to in picking software vendors. However, they soon realized that the initial metrics did not work well in this new environment:

> "*[Many managers] have grown up in a software industry that has been defined by vendors, defined by vendor relationships…. I think, that with open source you have to experience and do in order to be a credible participant and, you know, make* [yourself] *a credible commentator on it.*" (Senior Manager – Company B).

Below we overview how managers who were focused on building long-term partnerships engaged in a journey of learning how to make this new type of partner choice. Their approaches varied from project to project as well as based on their reflections upon lessons from prior projects and included 1) evaluating communities based on the value of the tangible outcomes they were offering, 2) understanding which communities are viable and could be relied on long term, 3) probing for which communities are friendly in partnering with corporations based on their ideology, processes, and governance; and 4) evaluating the health of an ecosystem comprised of a variety of external parties involved with the community as users and contributors. While our interviewees learned over time which evaluation metrics worked for which engagement goal, our data does not suggest that decision makers need to go through these phases of learning. Rather, each phase was associated with uncovering how a particular set of evaluation criteria for a partner achieved a certain goal, but not necessarily other goals.

4.1 Looking for Valuable Open Products and Services

Faced with the mandate from the top management to partner with open source communities for strategic gains, decision makers on the ground were struggling to relate what they were used to with corporate partner selection to the new mandate. As a result, they focused on the most visible aspects of an open source community's outputs such as open source license type (more or less corporate friendly), software product features, quality of the code, documentation, and support services. Our corporations have previously developed templates and metrics for evaluating the choice of commercial vendors to ensure financial payoffs from the relationships. In such alliances, there is an expectation of long-term dependence on the partner as software gets embedded in wider organizational processes and integrated with other technologies. This means that software upgrades, responsiveness to fixing bugs, and other support services were typically used as part of Total Cost of Ownership (TCO) calculations. Decision makers at Companies A and B tried to adapt these calculations to the new environment.

Soon, however, they discovered a challenge in adopting these metrics, as support services that were usually ensured through contractual arrangements with the partner were not guaranteed by an open source community. This meant that they had to either contract with 3rd party vendors supporting open source products (e.g., Red Hat for Linux), rely on the historical track record of a community in providing support services, or dedicate internal employees. While the cost of contracting for third party support services was fairly easy to obtain, these services were only available for a handful of widely adopted open source products. For many other open source engagements, the firm needed to either rely on support provided by

the open source community or invest in maintaining a proprietary version of the software. The latter meant forgoing the benefits of openness and incurring the cost of re-integrating with the open version when the two diverged. The option of relying on the community for support, if such support was of high quality was by far preferable. Thus, evaluating a community's track record of providing support services became a key part of our firms' assessment of the potential partner. Decision makers developed *"metrics around sort of velocity of Q&A and velocity of resolution of issues."* When this option failed, traditional project cost estimation tools were used to calculate internal support costs to be included into the Total Cost of Ownership calculation. Table 4 summarizes metrics used by decision makers to pick communities based on the costs and benefits of products and services that they were offering.

Table 4: Evaluating Community's Product and Services

2nd order theme	***1st order concept***
Product features	- Fit with corporate needs
Software quality	- Community size as proxy for testing (many developers 'eyeballing' the code) - Number of downloads by users (indirect measure of software approval) - Number and variety of email threads interrogating issues with the code
Documentation availability	- Availability of wiki HOW TO pages - Accessible FAQ pages - Level of detail of documentation - Speed of updating documentation
Corporate-friendly license type	- Reciprocity level demanded by the license - Possibility to dual license the software
Track record of community-based support	- Average velocity of Q&A - Average time for issue resolution
3rd party support costs	- Costs of contracting with 3rd parties for support services (only available for popular open source products)
Internal support costs	- Personnel cost of providing support services - Costs of maintaining multiple versions and reintegrating repeatedly

4.2 Looking for a Viable Community

As Companies A and B were experimenting with the new open source model, they started appreciating the innovativeness and quality of some of these products that came from the diversity, transparency, and open processes of such communities:

> "*I believe that what makes* [open source] *special is what I call the copy modify, share cycle [of code development]. … This type of innovation might be better referred to as 'diversity,' because that is really what the great thing that you are getting is -- the ability to follow lots of bets at once*" (Manager – Company B).

Moreover, firms' customers, to their surprise, held open source-based development in high regard and started pushing A and B towards offering more such products and services. As a result, in some areas, our firms moved from simply experimenting with this new model towards adopting it as part of their strategic

market offerings. This, in turn, meant that the firms that we studied, and their customers, needed to be able to rely on the community to keep innovating and supporting the product over long term.

Defining a community that corporate stakeholders could rely upon over time was not easy, as there were no readily available measures. Outcome-focused measures (from Table 4) were useful indicators of a community's output to date but not a guarantee of continuing innovation and quality. Thus, some forward-looking managers started developing new metrics that moved beyond the cost-benefit analysis of products and services and towards assessing a *community's viability*:

> "*How many people are in the community, how many people contribute, how often do they release, how many bugs they have on a given release? How many days does it typically take for a bug to be resolved on the community, how has it grown or shrunk overtime? … And those are the things that you evaluate to begin with and then monitor overtime to understand the viability of the [open source] project.*" (Manager – Company A).

The focus on viability meant paying attention to a community's evolution and momentum over time, looking for signs that the community was growing both in terms of product output and in the size and diversity of developer base. Managers learnt that by gathering open project metrics, which were readily available for many large open source projects through their version control software, which at the time was SourceForge (and more recently became GitHub). The development mailing provided managers with details about the key developers making substantial changes to the code. The vibrancy of the developer base was associated with a healthy amount of participant turnover and an opportunity for new members to rise in influence to become part of the core group. As a community grew, it was important that its members took on different roles, not only by contributing new code, but also by improving the product, reporting bugs, building new releases, and providing support. Informants in both firms noted that while they could gather a number of quantitative measures around community viability, they also often found it useful to *probe* the community through some peripheral participation to get a qualitative sense for its vibrancy. Table 5 summarizes metrics used in evaluating community viability.

Table 5. Evaluating Community's Viability

2nd order theme	***1st order concept***
Vibrancy of the developer base	- Number of active contributors - Growth of active contributors - Renewal of the core contributor group - Turnover of participants
Growth of the code base	- Lines of code - Number of subsystems
Attention paid to software quality improvements	- Number of bug reports - Number of upgrade patches made available - Number of testers (members eyeballing code) - Number of responses to questions

4.3 Probing for a Collaboration Partner Friendly to Corporations

As Companies A and B deepened their reliance on open source software, they increasingly encountered that open source products did not fully address their (or their customers') needs. Addressing this challenge by creating a propriety version of the software -- decoupled from the open source versions -- was less and less appealing, as nobody wanted to forgo the innovation and quality advantages provided by open source communities. This meant that companies had to find ways of *collaborating with communities* so as to entice them to accommodate company-specific needs. There were no readily-available *a priori* indicators of whether a given community would support company's agenda. Given no possibility of contracting with a community to support corporate needs, our firms started probing for open source communities where their influence would be accepted, and perhaps even embraced, and where community work practices were accessible to external parties.

Whereas before, decision makers were evaluating products and services first, now they were willing to give up the current fit between what communities were offering and what they needed, and instead consider whether "*the direction of the community [was] in line with the direction of the given [internal] product team long term"* (Manager, Company A). If the directions were aligned, they started asking "*which communities are open to corporate influence and work in a way that allows corporations to build productive relationships with them"* (Manager, Company A). Communities that were averse to corporate involvement on the basis of ideological reasons simply resisted requests from corporate employees, or anybody for that matter who was not part of the core group of developers.

A bigger issue arose when corporate development teams wanted to influence the core of the open software. The core source code was the crown jewel carefully guarded by a community, and it was not easy to influence. Companies were faced with a dilemma of needing to choose the community before they could fully assess whether their influence over the core product would be accepted. Our informants, when pushed by us to articulate what helped them to make an engagement decision in such circumstances, inevitably directed their responses to the governance form of the community. They were looking for communication, role, and authority structures that mirrored the corporate world. Some communities had more obvious authority structures, which made it easier for firms to distinguish who the influencers were. Other communities were more democratic. Managers argued that, "*You need some sort of executive decision-making capacity within the open community"* (Manager, Company B). They could then reach out to this authority in the hopes of receiving a definitive response. As one manager observed, too much democracy in the community could lead to corporate participants saying, "*The hell with you, I've got to serve my customers"* (Manager, Company B). Table 6 summarizes how managers evaluated a community's friendliness to corporations.

Table 6. Evaluating Community's Friendliness to Corporations	
2nd order theme	***1st order concept***
Community's orientation towards corporate engagements	- Evidence that past decisions were based on ideological rather than pragmatic grounds - Number of core developers who dropped-out in protest to corporate involvement in the community - Stated attitudes of community leaders towards corporate involvement - The degree of ideological influence of community leaders on others (e.g., their ability to overcome resistance if they are supportive of corporations)
Accessible communication processes	- Access to developer mailing lists - Consistency with which the community maintains online FAQs and transparent documentation trough wikis, blogs, and community sites - Direct access to specific developers
Clear governance structures within the community	- Clear and visible order of trusted maintainers of code versions - Clear delineation of responsibilities among developers for specific modules and tasks - Ability to discern leaders
Willingness to accommodate corporate interests	- Searchable history of past community decisions on product versions (related to any company) - Revealed desire by community to tap into a company's customer base for testers and users - Community's willingness to commit to agreed-upon release dates

While on occasion our companies found viable, corporation-friendly communities to work with, more often than not they needed to engage with the communities first and probe to see whether they could influence the development of communication processes and governance mechanisms that would result in good collaboration partners. Such influence was achieved by building reputation with community members by contributing developers, code, hardware, and other resources. Companies A and B were not just evaluating from a distance, but actually nurturing through direct engagement what they referred to as "*healthy communities*" – viable, corporate-friendly communities that consistently produced high-quality, innovative products and services:

> *"From my experience with open source, clearly the biggest benefits are when you have really established a healthy community, whether that's a community of committers but also a community of people who are using and providing you feedback about the software. You need that kind of cycle, that whole loop to be really a well-oiled machine, and in the best projects that is absolutely what happens, you get lots of feedback and you get lots of people's eyes on the code to improve the quality and that just continues to cycle forward as the software matures"* (Developer, Company B).

4.4 Probing for a Healthy Ecosystem

As we compared company documents from early days of open source engagements to a later time period, we noted a significant shift in the criteria used for partner evaluation for both firms. While initially the focus was on evaluating open products and services as well as community health, later documents paid more attention to other corporate players, including competitors, strategic partners, and clients, involved

with the community. Because overcoming internal resistance to working with open source communities was "*really, really difficult,"* the involvement of other reputable firms with the community was very helpful (Manager, Company B). Sometimes, our companies waited for others to demonstrate that a given community was worth pursuing:

> "*You were seeing all the companies waiting for the first one [corporate adopter] and then the second one to make the move, which were the bold ones. 'Oh my God! They are doing that move! What happens to them? They are collapsing, or they will collapse in two years maybe.' And you wait and when it works [you adopt]*." (Manager, Company B).

Often, customers were embracing the open source model faster than internal groups within A and B, and they were gravitating towards open source communities that had already developed a reputation among a wide set of corporations.

> *"Now we also are using S-drive adoption, and it's so early days, but what we found last year is that as soon as customers found out that the code was based on open source technology, they trusted it much more because they didn't have to overcome a mental gap of like hey, what does (Company B) know about managing Linux. It's no longer they trusted our offer, they're trusting the community's offer."* (Manager, Company B).

As pioneers themselves, Companies A and B were often the ones recruiting other corporations to start supporting communities that they were involved in:

> "*We're saying, let's go out and find a community that has a lot of corporations affiliated with it and saying, in order for us to make our own projects sustainable as a community project, not just as our project, we need to get other companies backing it*." (Manager, Company A).

As managers shifted their attention to the involvement of other firms, they developed quantitative metrics to measure such involvement. For example, a quick check of the mailing lists showed developer affiliation, which allowed our evaluators to estimate number and types of firms involved with the community. Company members also attended offline hackathons and open source conferences where they recognized other reputable firms that were involved. They also evaluated the nature of the donated resources, including paid employees working in the community, code donations, support services provided, and sales of the paid version of the software. As one manager noted:

> "*There needs to be money flowing through the system sustainably for people, for customers, to feel comfortable investing in the product and for developers to choose to spend their time honing their skills on it and for entrepreneurs to stake their businesses on it. So, the economy around a platform is important*" (Manager, Company A).

At the same time, managers started evaluating the technical features of the software code that would enable more firms to join as users and contributors. They looked at the concentration of APIs, the modularity of the code, and the number and range of complementary products being offered. They paid

special attention to the community's attempts to make the code reusable by diverse participants and not specific to any one contributor's needs.

The ability of a company to judge how the network of relationships around an open source community – an ecosystem – functioned was by no means immediate. It took some years of probing and learning before our companies were able to gauge which other commercial firms were involved in the ecosystem and how they were influencing critical decisions. Companies interested in joining an ecosystem would attend company-held or sponsored hackathon events where a mix of stakeholders usually showed up to network and learn about new projects being established in the ecosystem. Networking, discussions, and information sharing between all levels of stakeholders helped to establish a discourse about which company held greater influence and why.

Surprising to us, our companies, which were likely to be quite influential in the ecosystems they chose to join, insisted on the importance of a strong and meritocratic governance of the ecosystem involved rather than just exerting unilateral influence. They noted the importance of an ecosystem "*not being driven by one company's agenda*" (Strategist, Company B). The evaluation criteria shifted from the potential to build a promising proprietary relationship with a healthy community towards the appeal of participating in *a healthy ecosystem*. The latter refers to a sustainable, expanding set of diverse participants with a stake in the success of a given open source product, governed by transparent and meritocratic means. As one of the informants noted:

> *"I'd really just look at numbers of commercial customers who are paying for services that are around the platform... And numbers of employees at companies whose job it is to provide that support. I really think a lot of Project X's success has come from having a range of small firms that were going to take risks and be innovative…And you know it's not the best written open source management platform, but I think it's one of the very healthiest communities and one of the most sustainable projects by virtue of the way that the commercial process works around the platform"* (Strategist, Company B).

Table 7 summarizes indicators used for judging ecosystem health.

Table 7: Evaluating Ecosystem's Health

2nd order theme	***1st order concept***
Strength of ecosystem partners	- Number of partners - Types of partners - Reputation of partners - Degree of commitment to the ecosystem
Level of support by partners	- Code and hardware donated - Paid employees working on the project
Commercial acceptance of the chosen license regime	- The use of the same license regime used for distributing the core code in distributing products developed by ecosystem partners - Number of dual licensing schemes set up by partners (presumably to avoid using the license regime of the core code, or to change the business

	model)
Modularity of the platform	- Number of APIs - Number of modules shared and reused by partners - Number of modules developed by partners
Ability to reuse components and complementary products	- Level of reciprocity needed by the license - Generic versus specific nature of components - Degree of component embeddedness in partner's products - Number of competing versions (forks) of the product
Ecosystem governance structures	- Type of leadership model in the ecosystem - Reliance on open source foundations in governance - Clear rules and regulations for negotiations - Historical basis for making decisions (merit or influence-based)
Powerful influencers in the ecosystem	- Number of influential partners - Number of smaller players in the ecosystem and their alignment with influential partners - Relationship between influential partners and the focal firm - Merits for gaining influence

5 Discussion and Implications

Our investigations of how decision makers evaluated which open source communities to partner with revealed that they underwent a journey through which their understanding of the most relevant evaluation criteria evolved. In our analysis, the main task underlying these partnerships, which was to gain strategic benefits by incorporating open source software products into their commercial offerings, did not change over time. However, our informants realized that performing this task well involved achieving a number of different goals along the way, each requiring different evaluation criteria. Their learning journey allows us to theorize how different evaluation criteria fit different evolving goals of corporate partnerships with open source communities.

Our inductive findings resonate with Shah and Swaminathan's (2008) alliance partner selection framework. Similar to these researchers, we found that the most relevant criterion in partner selection varied with the situation. Moreover, we found that key evaluation criteria they have identified, namely, *trust*, *commitment*, *reputational complementarity*, and *financial payoff* could be usefully adapted to interpret our findings. For example, we can see that evaluating software products and services was focused on *financial payoffs*, while evaluating community viability was assuring community's long-term *commitment* to developing the product. Similarly, evaluating community's friendliness towards corporations was about establishing whether the community could be *trusted*. Part of the ecosystem health evaluation was about judging whether ecosystem participants had *complementary* market reputations which would create joint stakes in ecosystem's success. At the same time, our decision makers were also assessing other aspects of the ecosystem health and not just of the specific partner -- community. Consistent with Shah and Swaminathan (2008), we also see that all four criteria, whether assessed

quantitatively or qualitatively, were used in every decision, but some criteria were more dominant than others depending on certain contingencies.

A significant difference between Shah and Swaminathan's (2008) framework and our findings is that the *evaluation criteria used in choosing an open source community, with a handful of exceptions, were not applied to the potential relationship between a community and the corporation*[3] *but rather to the community in general*. For example, community viability metric was not focused on assuring commitment of the community to the firm, but rather on community members' general commitment to developing and maintaining an innovative, high quality software product. Similarly, corporation friendliness metric was focused on making sure that any corporation could trust the community as a collaborator and not just our firms. The two components of trust identified by Shah and Swaminathan (2008), goodwill and competence, were indeed very relevant, but they were assessed in general terms as goodwill towards any corporate involvement and overall community's process maturity. Ecosystem's health was not squarely focused on assessing complementarity between ecosystem participants' market reputations and the firm's own, but rather about complementarity among market reputations of a large number of organizations with the stake in the success of the community and its products.

Our firm's focus on evaluating healthiness of the potential partner as an entity rather than on the specific proprietary benefits that they would accumulate is consistent with the notion that in open innovation partnerships both private and public goods are created (von Hippel and von Krogh 2003). While our firms started with a traditional focus on creating proprietary gains from an alliance relationship by "taking" public goods and assessing how they benefited them, they quickly evolved their evaluation metrics towards overall community and ecosystem health. This is consistent with the notion that firms engaging with open innovation communities are participating in the creation of public goods that should over time give them some proprietary benefits, but not necessarily immediately (Baldwin and von Hippel 2011; von Hippel and von Krogh 2003; West and Gallagher 2006). Our firms quickly shifted their evaluation focus from a proprietary *value capture* in a relationship towards broader *value creation* in an open innovation ecosystem (Lichtenthaler 2011).

Shah and Swaminathan (2008) drew on organizational control theory to argue that the dominant evaluation criteria is dictated by the nature of the alliance project/task. They argued that alliance's task characteristics of outcome interpretability and process manageability defined the contingencies. If we were to draw on their framework literarily, we would be forced to classify long-term strategic corporate partnership with open source communities as having low outcome interpretability and low process

[3] For example, Shah & Swaminathan (2008) use relationship-specific measures such as "*How critical is it that ABC acts in good faith in pursuing mutual partner interests in this alliance?"* (p. 494)

manageability. This is because, due to the very nature of engaging with open innovation communities, corporations cannot fully control outcomes or processes in such communities. As a result, following the original framework, evaluators should primarily focus on those communities that exhibited reputational complementarity in the marketplace – communities that were part of well-established ecosystems with non-competing participants.

This is not what we found. Instead, our data suggests that decision makers did not perceive outcome and process characteristics as exogenous attributes of the alliance task. Rather they proactively shaped the alliance task and the evaluation criteria as they were learning how to better interpret what outputs they were getting from the relationship and how to manage processes with the community. Thus, they either focused on more interpretable outcomes such as costs and benefits of adopting a particular software product or less interpretable outcomes such as the degree to which future products and services had the potential for meeting corporate needs (as part of community friendliness metric). Similarly, for process manageability, company decision makers made tough bets on whether or not they wanted to get involved in with poorly managed communities and invest heavily into co-creating good process.

Finally, the new alliance tie between the firm and a community was not formed by picking the right partner for a particular alliance goal *a priori*, but rather the firms probed the communities through small scale engagements to see if there was potential for a productive alliance partnership co-evolution over time. Our informants clearly stated that it was impossible to understand the potential for value creation of a given open source community without participating in it. Similarly, it was hard or impossible to assess ecosystem health without both being part of an ecosystem and trying to shape it. Consistent with the partner-co-evolution perspective on alliance formation (Das and Teng 2000), corporations were willing to take risks in forging new partnerships without being able to perform a detailed evaluation of all criteria beforehand because they were willing to nurture open source communities and invest resources into ecosystem health so as to make these partnerships more attractive over time.

Integrating these insights in Figure 2, we propose a theoretical framework for evaluating an open innovation community as an alliance partner based on alliance goals.

	Process manageability: desirable	**Process manageability: not necessary**
Outcome Interpretability: not necessary	*Alliance Goal*: Co-develop with community *Key Criteria*: Trust in the community's willingness and process competence in collaborating with corporations *Evaluation Metric*: **Community's Friendliness to Corporations**	*Alliance Goal*: Supply and demand -side network effects in the ecosystem *Key Criteria*: Strength and complementarity of interests among ecosystem partners in the long-term success of the community *Evaluation Metric*: **Ecosystem Health**

Outcome interpretability: desirable	*Alliance Goal*: Rely on the product long-term *Key Criteria:* Contributors' commitment to keep producing the product *Evaluation Metric:* **Community Viability**	*Alliance Goal*: Adopt the product *Key Criteria*: Financial payoff from using the product *Evaluation Metric*: **Firm's Value from Community's Product and Services**

Figure 2: Model of Selecting Open Innovation Community as Firm's Alliance Partner

6 Implications to Research

As strategic corporate partnerships with digital open innovation communities are becoming more popular (Bogers et al. 2017; Greenstein and Nagle 2014), the number of communities that corporations can choose to partner with also grows. Yet, innovation management literature to date has not investigated how such alliance partners are chosen by organizational decision makers. We have investigated this question and propose a number of insights for the strategic alliance and digitization of innovation literatures.

6.1 Implications for Strategic Alliance Literature

Strategic alliance literature has historically focused on organizations forming alliances with other organizations using commercial arrangements such as signing contracts and investing equity (Kale and Singh 2009). We have argued that in its goals and nature a long-term strategic relationship with an open innovation community often serves the same purposes (e.g., conducting joint R&D or co-promoting a product) as a commercial strategic alliance. Moreover, recent empirical studies of software alliances (Han et al. 2012) treated relationships formed among commercial firms through their joint participation with the same open innovation community as examples of strategic alliances even though such alliances do not rely on traditional commercial arrangements. Our paper also proposes to treat a long-term strategic partnership with an open innovation community as a new digitally-enabled form of strategic alliance relationship, but we suggest that such a relationship could be formed between a firm and an open innovation community and not just among firms. Our work demonstrates how insights from traditional strategic alliance literature (e.g., Shah and Swaminathan's 2008 framework) are relevant to studying these new relationships emerging in the digital age. We encourage future researchers to take this "traditional" literature seriously as they explore questions of governance, evolution, and outcomes of this new digitally-enabled forms of alliances.

Strategic alliance literature has extensively discussed tie formation among partners in an alliance (as summarized in Table 1), but, to our surprise, the actual decision making of organizational actors in choosing alliance partners has not been studied extensively. Shah and Swaminathan (2008) undertook such a study and built an insightful theoretical framework, but they were not able to access decision

makers in their organizational context and relied on MBA students in evaluating their framework. We contribute to the literature on alliance tie formation in three key ways: 1) by conducting a rare empirical study of decision makers evaluating alliance partner choices in their organizational context; 2) by extending alliance partnership formation literature to new types of digitally-enabled innovation partnerships and showing how the framework changes as a result; 3) by highlighting the role of value creation over value capture in digital ecosystems. We will now elaborate on these three factors.

First, our empirical investigation of the criteria that organizational decision makers were using in evaluating alliance partners revealed that they did not see the alliance task as having exogenous outcomes and process characteristics as proposed by Shah and Swaminathan (2008), but rather engaged in actively shaping whether they wanted to focus alliance goals on more or less interpretable outcomes and whether they wanted to invest in costly process management or not. This happened within the context of the same overall alliance task (of developing commercial offerings based on open source products), suggesting that recent literature that highlights the role of alliance task in alliance formation (Furlotti and Soda forthcoming) does not fully explain variations in our findings. Shah and Swaminathan (2008) used specific examples from the airline industry such as evaluating a partner for a code-sharing alliance versus evaluating an equipment supplier, which implied certain outcome and process characteristics. However, in practice, it is possible that these aspects of the relationship are associated with strategic goals of the alliance and not with objective task features. Future strategic alliance partner choice studies can help shed light on whether this finding is only relevant to digital innovation, which typically exhibits ambiguous goals (e.g., Fayard et al. 2018) and processes that are constantly in flux (Gulati et al. 2012) or is more generally common to all types of alliances than previously assumed.

Second, our study extends Shah and Swaminathan's (2008) framework to the new types of digitally-enabled alliances that are not governed by traditional commercial arrangements and that involve co-creation (Barrett et al. 2015) of public as well as private goods (von Hippel and von Krogh 2003). It was somewhat surprising to us that in spite of the differences in the governance regime, the key criteria identified in the framework and their relationship to process and outcome characteristics stayed relevant in our context. At the same time, the actual translation of these criteria to the new phenomenon was far from direct. Indeed, criteria such as partner's commitment to the relationship seems hard to apply when a community of volunteers on a digital platform is often anonymous, has no formal obligation towards the corporation, and may be ideologically opposed to partnering with firms without making its opposition explicit until corporate engagement is already under way. We found that each of the four original criteria took a new form in this context, but, most importantly, that the evaluation was less focused on proprietary value capture in the relationship and much more focused on public value creation. Strategic alliance

literature has consistently acknowledged the importance of such value co-creating alliances (Barrett et al. 2015) over the last 20 years (Doz 1996), but has not explicitly incorporated the focus on value creation (vs. capture) as an alliance partner selection consideration. This can be largely explained by the rather economics-driven slant in the literature. Yet, modern economics also accounts for the possibility of private benefit through public good creation (Brandenburger and Stuart Jr 1996). It is not entirely surprising, therefore, that decision makers are paying more attention to this public benefit than they were previously given credit for. Future studies should consider to which degree value creation versus capture enters corporate decision makers' evaluation criteria in alliances partner selection outside the context of open source alliances. Certainly, if scarce high-quality human resources are only willing to participate in healthy communities (Crowston et al. 2006), it is likely that consideration of community and ecosystem health will continue playing important role in partner evaluations beyond proprietary gains.

Third, while strategic alliances literature offers plenty of evidence that new alliance ties are likely to form on the basis of social relations in inter-organizational networks (see Table 1), inter-organizational network considerations are not directly discussed in Shah and Swaminathan's (2008) framework. Our findings show that these considerations were on the forefront of decision makers' minds in choosing open innovation communities. This is not surprising given the importance of network effects in digital ecosystems both on the supply and demand side (e.g., Eisenmann et al. 2009; Wareham et al. 2014). While in our context ecosystem considerations were closest to the complementarity criteria in Shah and Swaminathan's (2008) framework, ecosystem health is a much broader concept. Digital goods with high up-front fixed costs and strong network effects create synergies among diverse participants that go beyond aligned reputational stakes (Furr and Shipilov 2018; Helfat and Raubitschek 2018). Digital ecosystems bring together parties with directly conflicting goals (e.g., buyers and sellers or direct competitors), who, nonetheless, still have a common stake in maintaining a healthy ecosystem.

6.2 Implications for Research on Digitally-enabled Open Innovation Communities

There are a number of research implications for the literature on corporate engagement with open innovation communities. First, within open source literature, most studies that considered issues pertaining to community health take a perspective of a developer deciding which community to join. There is some degree of overlap between our findings that pertain to community health and this prior work. For example, researchers explored quantitative factors that could be used by a developer to indicate whether a given open source community is worth joining such as bug-fixing time, popularity of the project, and community size (Crowston et al. 2006; Izquierdo-Cortazar et al. 2010; Raja and Tretter 2012; Soto and Ciolkowski 2009). Some studies in this stream suggested that not only measurable markers, but also "social health" features such as knowing where a new developer can get help should be considered as

well (Head 2016). Perhaps, the most significant work in this domain focused on operationalizing ecosystem health by drawing on four prior published studies, all of which relied on archival data from code repositories (Jansen 2014). This work proposed a number of metrics that were consistent with those used by our informants such as metrics focused on product and support services (Table 4) and numbers and type of ecosystem participants and product modularity (see Table 7). While this work went into great depth in measuring things that can be scraped from code repositories, given its research goals, it did not focus on strategic factors involved in having a corporate entity engage with the community (e.g., corporate friendliness or license type), nor did they consider factors that are not easily assessed from code repositories such as the presence of democratic governance. Those researchers that have discussed community governance (Laffan 2012) still considered whether important decisions are accessible to a volunteer participant, not necessarily a corporate entity. Overall, our work builds on this stream of research and adds a number of considerations that are important to corporations that may not be directly relevant to volunteer developers. Most importantly, we show how various measures of community or ecosystem health relate to diverse goals of engaging with open innovation communities.

Second, as already noted, both community and ecosystem health criteria used by our firms focused more on value creation than value capture. This is in contrast to prior studies of corporate engagement in open innovation that focused more on value capture, foregrounding such characteristics as a firm having influence on ecosystem decisions (Morgan et al. 2013) or benefiting from ecosystem participation of market leaders (Adner 2006; Han et al. 2012). Our findings partially align with this prior work in that our decision makers also paid attention to the resources invested by others in the ecosystem and product market synergies. However, when it came to the issue of influence, our companies soon realized that limiting the amount of influence any one player could exert (including their own) was crucial in sustaining a healthy ecosystem. Moreover, making sure that product architecture was built for wide reuse by potential future ecosystem participants (possibly competitors) meant again focusing on value creation at the expense of, at least in the short term, value capture. This finding is consistent with much of the writing on value creation versus value capture in open ecosystems (e.g., Eisenmann et al. 2009; Gawer 2014; Wareham et al. 2014). Our work contributes by pointing out specific quantitative and qualitative criteria that firms can use in measuring ecosystem's potential for value creation and value capture. While our participants did not optimize tradeoffs between these various criteria formally, future research can actually focus on doing such modeling, for example, analyzing tradeoffs between numbers of generic versus partner-controlled components in the ecosystem.

Speaking more broadly to the literature on digitally-enabled (Rolland et al. forthcoming) open innovation beyond open source (e.g., Felin and Zenger 2014), we find that this work also rarely asks the question of

how to find the right partner. Theoretically, this literature would suggest matching community expertise with the company's innovation task (e.g., Arazy et al. 2016; Felin and Zenger 2014; Lifshitz-Assaf 2018). Today, however, there are more and more open innovation communities offering similar professional expertise such as Kaggle, TopCoder, and Upwork for data science; NineSigma and Innocentive for scientific innovation, DesignCrowd and 99Designs for graphic design (e.g., Boudreau and Lakhani 2013; Kaganer et al. 2013). This means that firms have to go beyond choosing a partner based on whether its expertise fits their problem, towards evaluating community, and perhaps ecosystem, health. Future research can dig deeper into how these concepts and their measures vary across communities engaged in different types of work.

6.3 Limitations

Our work has three main limitations. First, as there was no readily available framework within open innovation literature focused on selecting an open innovation community, we appropriated a model from alliance literature. We had to adapt the model by Shah and Swaminathan (2008) to fit our purpose. While the correspondence between our inductive findings and deductive framework was not perfect, building on prior scholarship allowed us to interpret our findings in a more parsimonious and integrated fashion. At the same time, the differences between the framework developed for commercial alliances and our data helped us understand which aspects of the partner evaluation process were specific to this new setting and which ones were general to both old and new phenomena.

Second, our study focused on open source community partnerships, which following a well-established research tradition (e.g., Shah 2006; von Hippel and von Krogh 2003; West and Gallagher 2006), we treated as examples of open innovation communities. It would be important for future studies to investigate which aspects of our findings are idiosyncratic to the open source context and which ones are generalizable beyond it.

Finally, we focused on the multi-decade journey of two pioneer firms forming alliances with open source communities. It is possible that some of the goals and evaluation criteria used in forming these alliances are no longer relevant, while others have become dominant across industry. Moreover, it is possible that smaller or younger firms may have slightly different sets of concerns in entering an alliance partnership with an open innovation community than our firms had, necessitating further investigation.

7 Conclusion

Our work addresses the important question of how organizational decision makers select which open innovation communities to engage with as an alliance partner. While in the early days of company engagement with digitally-enabled open innovation communities this question was peripheral due to the

lack of choice in partnering, today, more and more open innovation communities are receptive to corporate engagement. The blurring of boundaries between internal and external work as well as between innovation processes and innovation outcomes associated with digital innovation (Nambisan et al. 2017) makes it particularly hard to make such evaluations. Moreover, the openness of participation and anonymity and fluidity of participants often characterizing digitally-enabled innovation communities (Faraj et al. 2011) leads to great difficulty in applying traditional criteria of trustworthiness and competence in choosing an alliance partner. Finally, digitally-enabled open communities are constantly evolving (Gulati et al. 2012) making partnering with them a moving target and necessitating a great degree of flexibility in adjusting organizational goals in such partnerships.

We found that pioneer firms we have studied addressed these challenges head on. They learned from their experiences with digital innovation and developed new criteria for choosing open innovation communities as their alliance partners. The ability to define and collect these criteria benefited from the transparency often associated with processes and outcomes on digital innovation platforms (Nambisan et al. 2017). In the beginning, this very transparency prompted decision makers to focus on the most visible aspects of innovation – the value of tangible products and services produced by the community. Eventually, however, industry pioneers learned to move away from easily observable characteristics and developed more nuanced ones. They also learned to give up an outdated mindset primarily focused on private value capture from specific outcomes and embraced new categories of value more appropriate for the goal of partnering with the community in order to co-create public goods. Developing these measures inadvertently helped managers better understand the actual value proposition of participating in an open digital ecosystem.

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Appendix

Appendix 1: Relating our data to Shah and Swaminathan (2008) criteria		
Shah and Swaminathan's Definitions	**Data Quotation**	**Our contextualizing notes**
Trust Partner's goodwill and avoidance of opportunism and confidence in partner's ability to perform alliance task	*It pretty much comes down to what our customers want and what solution they are most comfortable with and again the total cost of ownership. Do we see the expertise to administer one of those solutions and is one community more competent than the other than another and that's probably the one that we are going to be more comfortable with*	Trust as evident from a sense of competence and expertise of the open source partner.
	You know, the traditional models have been used in companies were very clunky, and nobody likes to use them because it seems like all contribution and no report but they found that with this open source approach, you know, that they were getting expertise coming in, they were getting better quality solutions.	Competence based trust and reliance on open source community code offerings.
	First of all what comes are the synergies. You always have to look at the evolution of any bit of code. As in the last five years, if your answer is yes then, is the code you want supported by many others and that are leading … for what you need. This is where the community are important. These communities also hopefully make sure if individual and also other companies involved and so you will see that there will be more parties having similar concerns and similar difficulties as you are not the only corporate partner. In many cases someone has to start stepping in first. When you have the technologies and you want to hire people, so it is good that there is a community and any key contributor is a potential employee or any company there is a potential partner. All these aspects are important. Actually, it's not just pieces of software but that they are sustained by the community – which is alive.	Trust built by collective contributions and signals of expertise. This fragment of interview data also resonates with commitment ideas – but we note a gentle building up of goodwill based trust through communal and collective contributions.
	We needed to have a trustworthy, credible proven technology. So we worked with an open source application. All that innovation was already done, it was out there and product development was much faster because we adopted that as the basis for our management aegis.	Signal of expert software and clear capability offered by a good open source product.
Complementarity Reputational complementarity	*In fact the patch tells you something else far more interesting which is it is a vote for a feature where instead of somebody saying I would love such and such, they have actually put some effort in and*	Reputation here is seen more as a signal from the community which is interesting – but not as a PR

among partners' market reputations creating joint stakes around image with the customer	*done it, so you have shown them by expending some time, reputational capital, something that is important to them. So in open source this is how you look for things, you look for the things that have cost people time and money, so and you wait in favour of those.*	appeal by the alliance-seeking company.
	Now we also are using S-drive adoption and it's so early days but what we found last year is that as soon as customers found out that the code was based on open source technology, they trusted it much more because they didn't have to overcome a mental gap of like hey, what does (company X) know about managing Linux. It's no longer they trusted our offer, they're trusting the community's offer.	This section of data clearly signifies trust yet the main argument being made here is how customers recognized the value of open source and the company in question felt that making more of their engagement with open source would help attract more customers.
Commitment Partner's explicit or implicit pledge to make a tangible contribution to the relationship	*One thing, we sponsor those communities in some way or another for example, we donate most of the hardware for their infrastructure. We sponsored different events like, Apache or even smaller community advance…so we did involve both with money and with contributions.*	Commitment through contribution: contribution to the product directly but it signals commitment to the larger ecosystem – thus attracting more partners.
	Talk about how they are moving towards a more organised development model, which … by all means continues to encourage the contributions from the industry at large, but, at the same time, keeps things more on track in terms of here, we are moving to this goal and the next goal and it's not as patchy as it has been in the past. So, I do see the overall maturity of open source as it gets better and better to meet enterprise needs. I can see that improve. Also another part that helps there is, when you have these projects and, again, the more visibility they get, the more they are able to solve enterprise customer needs, the more that people from the community themselves will be able to contribute content.	Ecosystem level commitment is crucial for sustainability of the community.
	Certainly the viability of the community. How stable is the software? How viable is the community around it? Are they fixing bugs? Looking at the list to see, are people responsive to problems or bugs getting fixed. Is the community committed to supporting it? That's one of the big ones. It is possible to sub contract to smaller companies for support for this.	Commitment needs from the community and looking at the community level rather than larger ecosystem. This aligns with product related issues as a signal of health.
	What appeals to me, I think, is mainly two things. The fact that you are working with open standards as well. But the fact that you are working with an array of people. You've identified	This was a response to our question of why this company chooses to work with open

	some common problems and then you are working within an array of people not within your own little, you know, company. The fact that you are bringing all these different people from all these different areas gives you the feeling that you are ultimately building something that is most acceptable to the widest array of end users, because you started with such a wide base of people feeding into the requirements. And, also, along with that, theoretically, you should get better coverage in terms of requirements, but also a sort of chair view of what's happening and what's the right direction to take on different topics. You can work solo on anything, really, but doing it as a group, you are going to bring in the group dynamic which causes more ideas to be brought in typically… humans just have to work better that way and be more successful, when the group dynamic is allowed to exist.	source communities.
	What you are talking about is really how do you encourage more collaboration and more development or participation I should say, all on these open source projects where maybe you are leaving it, but you really want it to sustain and you want to get as many folks interested as possible. We have different incentives for doing that. It's more of the focus to try and figure out, how do you promote, reuse and encourage people to participate and behave in this kind of more of an open source development methodology.	This quotation is coded with commitment. It is also suggestive of ecosystem values.
Financial payoff Tangible sources of value including reduction in costs, increase in profit, access to new markets, etc.	*Well, for the company involved it is driven by a project that you feel can help you do a better job with cheaper, faster, higher quality, if you use open source software, so that happens quite a bit and it can mimic systems inside of our company.*	Replies often to the question of how the manager chose the open source project to work with. Financial payoff recognized in the form of more efficient and cheaper software
	We just got lucky that those things came together … I can still remember some of the discussions we had at executive levels at (our company). Were you guys on drugs? What do you want to do? It was a pretty radical… essentially we are commoditising. The pitch to our business partners was luck. We all want to work together to solve customers' problems. As a group, we've got limited amount of capital to invest. It's the nature of the business, right? How are we going to invest to best meet our customers' needs? We can all	This was a reply to the question of why they moved into open source when there was no clear business model. Ecosystem value is evident here as is the idea that value creation and value capture are both layered in theory and practice. Companies are able to create some value together

	choose to write the same thing over and over and over again. Whether that's ten million dollars a year, we can all choose to spend ten million dollars a year to do the same thing repetitively to really give value to our customers or, we can choose to collaborate and with our contributors spend ten million dollars once and then use all the capital that's left, and individually invest in value on top of that and choose to compete.	while holding competitive value creation separate.
	The open source market started with only basic and very infrastructural requirements and then we added services and more value added services and more and more and more and we are on top of different layers and we are now offering very high quality and high level layers of services. But at each layer, you were seeing all the companies waiting for the first one and then the second one to make the move, which were the bold ones, oh my god, they are doing that move. What happens to them? They are collapsing and they will collapse in two years maybe? And you wait and when it works, okay, it works. I read in some magazine that they were making a lot of money thanks to that. I have some pressure from my CEO to cut my expenses. I could do that and so then, when you have examples and you are under pressures, you slowly begin thinking that you could do that too. But you wait, always for someone to do it first. The first one usually is really a bold one.	This interviewee explained that the initial move into using and working with open source communities involved the bold first movers – value creation and capture were both hazy with regard to open source. Once the ecosystem began to grow then more companies jumped in to reap different forms of value.